Inventory & Monitoring
Pacific Island Network

National Park Service
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Pacific Island Network Quarterly

Innocent Until Proven Guppy

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HOT TOPIC

Koa-munching moth outbreak

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The National Park Service (NPS) has implemented natural resource inventory and monitoring on a servicewide basis to ensure all park units possess the resource information needed for effective, science-based management, decision-making, and resource protection.

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NOTE: Unless indicated all photos and articles are NPS.

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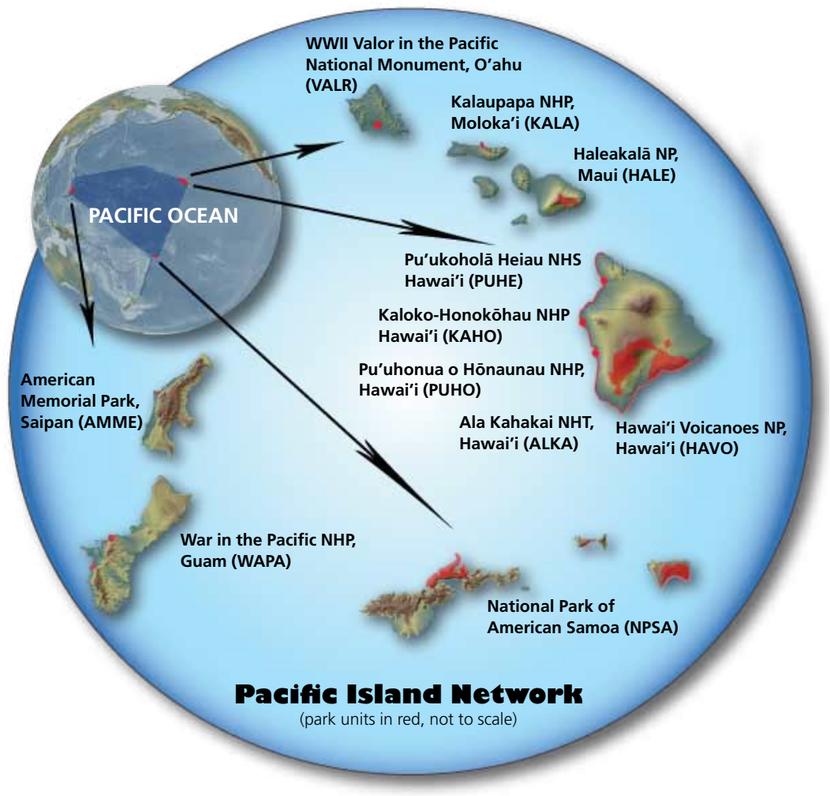
Field Schedule

	July	August	Sept.
Anchialine monitoring	HAVO (pilot)		
Invasive plants	NPSA	NPSA, HAVO	NPSA, HAVO
Vegetation communities	NPSA	NPSA	NPSA
Water quality	HALE	NPSA, KALA	
Stream animals	HALE	NPSA, KALA	
Ground water			
Benthic marine		WAPA	
Marine fish		WAPA	
Vegetation mapping	HAVO, HALE	HAVO	HAVO
Climate (on-going)	All Parks ----------		



HOT TOPIC

Koa-munching moth outbreak in Hawai'i Volcanoes NP

Over the past few months, koa (*Acacia koa*) forests on the Big Island of Hawaii, including those at upper elevations within the Mauna Loa Strip section of Hawai'i Volcanoes National Park (HAVO), have experienced a dramatic outbreak of the koa looper (*Scotorythra paludicola*). This native caterpillar feeds almost exclusively on koa foliage. While this event is not unique, it is a relatively rare phenomenon, having been documented only 12 times in the past 120 years. The total area affected by the outbreak has not been determined, but nearly all large stands of koa on the island, ranging from windward Mauna Kea to the southern flanks of Mauna Loa to the Pu'u Wa'awa'a region of Hualālai, have been impacted to some extent. In many areas, massive caterpillar feeding has resulted in complete defoliation of the trees. This outbreak appears to represent the largest ever recorded in Hawaii.

Within HAVO, the outbreak has been most evident along Mauna Loa Road, particularly between about the 1,500 and 2,000 m elevation. Starting in early May 2013, caterpillars could easily be observed feeding on the "leaves" (phyllodes) of nearly every koa inspected in that area, particularly trees that were producing new, highly palatable foliage at that time. As of the middle of June, the caterpillars largely finished feeding and most appeared to be in the pupal stage (transforming into moths), or in some instances had already emerged and were seen flying in the area. Within a week or two, huge numbers of koa looper moths may be visible along the upper section of Mauna Loa Road. Where these moths go and whether or not they start a new outbreak is unclear. There is still much koa foliage at lower elevations within the park (e.g., near Kīpukapuaulu, around Kīlauea Crater, and along Chain of Craters Road) that could support a second wave of infestation.

Rain before the clouds - "*While conducting vegetation fieldwork in the Mauna Loa Strip, one week it seemed like it was raining caterpillars. The next week we walked through clouds of moths.*" –M. Simon, NPS

Under normal conditions, the koa looper is just one of several species of *Scotorythra* that can be found feeding on koa foliage. It is one of the smaller *Scotorythra* species and generally goes unnoticed, consuming only a small percentage of foliage. Why does the koa looper experience occasional outbreaks? No one knows for sure, but it may be due to a relaxation in predation or pathogen pressure, a decrease in chemical defenses within koa foliage, favorable climatic conditions, or some other factor. And while it is unknown what initiates the outbreak, it is also unknown what causes it to stop.

Observations from previous outbreaks suggest that the mortality of healthy koa following defoliation is very low, although death rates as high as 33% have been found in areas where trees were stressed prior to the outbreak.

While concern for the health of koa in HAVO is real, as tree death would change the forests and affect ecosystem processes, the large number of caterpillars during an outbreak likely influences forest communities in less obvious ways.

In some ways, caterpillar outbreaks may even be beneficial. For example, it is known that caterpillars are important food for birds, particularly during the nesting season (which is generally concurrent with the outbreaks). Caterpillar levels not seen for decades such as we are experiencing right now, may result in higher nesting success for native species such as the Hawai'i 'amakihi, 'apapane and 'elepaio.

The full extent of the outbreak will not be known for many months, but it is clear that HAVO, like much of the Big Island, is experiencing a spectacular natural phenomenon involving an often overlooked native insect and its more famous host plant.

–Robert Peck, HCSU, UH-Hilo Entomologist

Benthic Marine (Seafloor) Update at Kalaupapa National Historical Park

Kalaupapa National Historical Park (KALA) is located in Hawai'i on the north shore of the island of Moloka'i. Found within KALA's nearly 2,000 acres of nearshore marine waters are a variety of submerged marine resources, species, and habitats. The typical marine habitat is highlighted by large boulders and coral reefs. Coral reefs provide habitat for thousands of organisms. A growing and reproductively active reef is a sign of a healthy marine ecosystem and upland water system.

METHODS & MEASUREMENTS

Divers annually monitor coral reefs by recording the abundance of coral and other bottom dwelling species through photographic interpretation (pictures of the seafloor taken every meter to detect plant and animal species, disease, and bleaching), rugosity chains, and coral settlement arrays.

From 2006-2010, a total of 150 twenty-five meter transects (the sampling unit) were surveyed, with 30 transects surveyed annually. Fifteen transects were randomly established at the onset in 2006 as permanent transects and subsequently surveyed on an annual basis. The remaining 15 temporary transects were randomly selected each year and surveyed only in that year.

Boulder habitat typical of a survey transect at Kalaupapa NHP

The benthic monitoring program at KALA consists of four components obtained through SCUBA surveys:

1. The 25 photographs taken along each transect are analyzed to assess long-term changes in the percent cover (how much of the seafloor is covered in corals, algae, or invertebrates). Changes may indicate certain environmental stressors or drivers. For example, an increase in algae has been associated with increased nutrient levels or a reduction in the number of herbivorous invertebrates or fishes.

2. Also assessed from the photographs is the incidence of coral disease and bleaching. Physical water conditions (e.g., temperature) often correlated with disease or bleaching are monitored through other Vital Signs.

3. Rugosity is a measure of structural complexity of the seafloor (bumpiness or topography of the seafloor). Changes in rugosity may indicate large scale changes in community structure, composition, function, and condition. Research has established a strong link between rugosity and the abundance of fishes and mobile invertebrates.

4. Coral reef populations must successfully reproduce and recruit to persist. The failure of juveniles to recruit can result in relatively rapid degradation of the coral reef ecosystem. Coral settlement rates of coral larvae provide an integrated measure of larval supply, suitable substrate (favorable places to settle), and water quality. Coral settlement is estimated by assessing new coral larvae settling on ceramic tiles set up along transects.

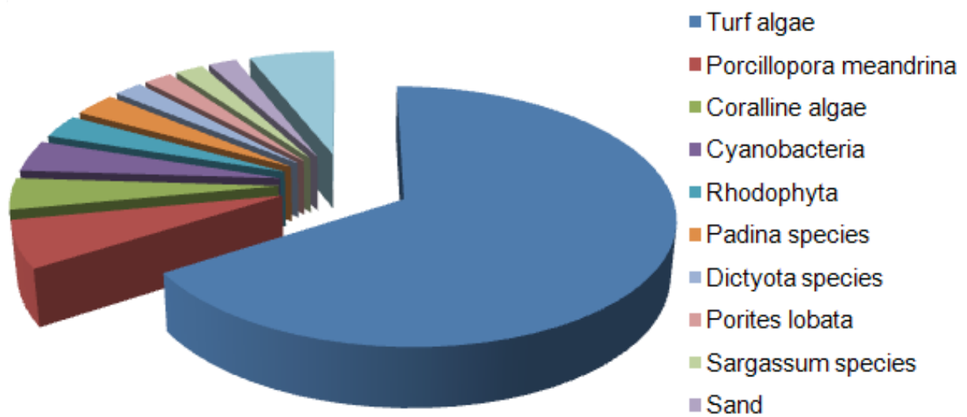
25 photographs of the seafloor are taken along each transect

Each photograph is analyzed to detect the presence of different species or disease

OBSERVATIONS & TRENDS

- Average coral cover remained relatively stable at 9%. Transects with the most coral were located near the northern tip of the peninsula, while the lowest coral cover values were concentrated near the eastern and western boundaries of the park.

- Coral species diversity remained stable. The total number of unique coral species was 22, with an average of over four species per transect.



Seafloor survey results, 2006 - 2010

- Coralline algae was relatively unchanged from 2006 to 2010, and averaged 4%. Transects with the highest amount of coralline algae were near the northeastern tip of the peninsula.

- Turf algae decreased from 76% in 2006 to 60% in 2008, and then increased to 64% by 2010.

- Macroalgae cover was slightly higher near the eastern and western boundaries of the park below the cliffs. Average macroalgae cover increased from 8% in 2006 to 26% in 2008, and then to 22% in 2010. This trend, however, is not significant.

- The percentage of photoquadrats showing signs of disease or bleaching was generally low and ranged from 0.3% in 2007 to a high of 4% in 2010, with an overall average of 1.3%. The increase in coral disease/bleaching was statistically significant across years. Transects with the highest incidence of disease/bleaching were located around the northern end of the peninsula and at one site on the western boundary of the park.

- Rugosity was generally higher along the northeastern edge of the peninsula and less below the cliffs. The survey data indicated no ecologically relevant change in relief.

- Coral settlement rates were not statistically different among years. *Porites sp.* were the most common larvae identified, followed by *Montipora sp.* and *Pocillopora sp.*. Coral larvae settlement was the highest near the northern tip of the peninsula, and lowest near the eastern and western boundaries of the park.

As of 2010, the benthic community at Kalaupapa National Historical Park appeared stable and was typical of other north shore coral reefs in the Hawaiian Islands.

NOTES FROM THE FIELD

Asan River

The parking area behind the church could easily be overlooked if you didn't know what it led to. The stairs built on the hillside lead you into tropical forest. Reaching the top you find the first of three 5 ½ inch guns. That's 5 ½ inches in diameter, or

the size of the shells they could fire. The barrels themselves must be 20 ft. long. These are the Piti Guns, a defensive position installed by the Japanese in 1944 on the island of Guam. The guns were discovered after fighting had stopped, for they were not ready to fire when the Americans landed to liberate Guam and the Chamorro people during World War II.

War in the Pacific National Historical Park (WAPA) on Guam is known for its historical significance, but many are not aware of its natural history. The Pacific Island Network freshwater monitoring team recently spent three weeks sampling in WAPA and in American Memorial Park on Saipan. We focused much of our efforts on examining Asan River in WAPA. This river flows from the uplands above Asan Beach, which was one of the two initial landing zones for the American invasion.

This expedition gave us the opportunity to implement the improved safety procedures mentioned in a previous newsletter. Being a somewhat modern historical battlefield, for example, it is always possible that we might run across unexploded ordinance left over from World War II. Thankfully, we didn't see any this trip. We did encounter plenty of metallic debris, mostly roofing material blown into the riverbanks during typhoons. Such hazards are the reason why all field sites must be afforded caution and respect, even if they are physically close to civilization. But it's the appeal of getting into the field that attracted our small army of volunteers, who were mostly active-duty personnel from the large U.S. military presence on Guam.

The Asan River has several distinct ecological zones. Upstream, the river flows through open canopy areas cut deeply into ravines. Sunlight reaches the water, promoting extensive algae mats. Here it is easy to find very large Tahitian prawns, with bodies up to six inches long, and claws an additional six inches in length. Downstream, the land flattens out a bit, and the stream becomes so wide, shallow, and overgrown it is essentially a wetland. Next, the stream drops through a series of cascading waterfalls into the forest. Here the canopy closes in preventing much direct sunlight from reaching the water.

Large snails, as big as the last digit of your thumb, favor this section as they can hide under cobbles in the stream. Lastly, the stream empties into the largely-developed, flat coastal area before reaching the ocean.

A recent biological survey of the shrimp community in Asan and nearby rivers revealed several species new to science.

Despite the pounding this land received 70 years ago and the intermittent typhoon devastation, diverse life continues to persist, although we will never know what might have been lost. Today, the land around Asan River is heavily developed for housing and other human uses, representing new threats to the ecosystem.

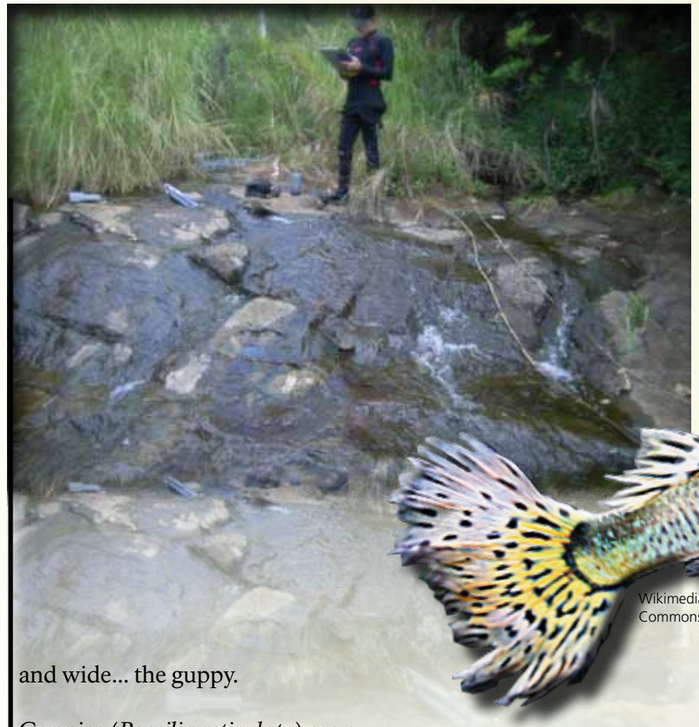
Fortunately, for the river and the animals who live in it, the NPS Inventory & Monitoring Program in Asan River is now in its fourth year. When we monitor the river every year we are better able to keep tabs on ecological changes. This yearly update informs WAPA resources managers to make the best decisions concerning the natural resources of the river and surrounding park areas.

–David Raikow, NPS
Aquatic Ecologist

Innocent Until Proven Guppy

Guppies in Guam streams may be big trouble.

Over 60 non-native species of fish are living in the streams and freshwater pools of the Pacific islands. One species is known far and wide... the guppy.



Surveying the stream animals along Asan River in War in the Pacific National Historical Park helps the NPS detect when a new species makes its way into the river.

Wikimedia Commons

Guppies (*Poecilia reticulata*) are a popular aquarium fish due to the brightly colored tails of the males, as well as their general heartiness and widespread availability at pet shops.

These tiny *poeciliid* fish have been introduced to Pacific streams for a variety of reasons. To be clear, they don't belong there. Originally introduced to freshwater areas in the Pacific as a form of biological control for mosquitoes, it is suspected that they are now most often released into fragile streams and ponds by aquarium owners.

Although seemingly harmless, these fish can pose a serious threat when introduced to sensitive native stream ecosystems which have developed through time without these wee foreign invaders.

Recently, on a monitoring trip to Asan River in War in the Pacific National Historical Park on Guam, the Inventory and Monitoring Program discovered a population of guppies living in one particular segment of the waterway. This discovery prompted scientists and managers to consider the potential impacts of introduced guppies in Guam streams.

So how do guppies and other *poeciliids* threaten Pacific island streams and ponds?

First of all, guppies have long been known to reproduce quickly. They are prolific breeders capable of producing over 100 fish in a single brood... in as little as five weeks ! They are also live bearing fish which can result in a single pregnant female establishing an entire new population. Add these traits together and you can rapidly wind up with a lot of little fish.

Research has shown that these small fish prey heavily on native aquatic insects. It is likely that guppies have contributed to the decline or extinction of three species of native stream-breeding damselfly species in Hawaii. They can also be carriers of non-native parasites (including nematodes and tapeworms) that could be transferred to native stream fish.

While none of these effects have been specifically documented on Guam, the potential consequences of guppies are enough to raise a red flag for park managers and consider possible interventions.

Early detection of invasive species like guppies is the key to early control. Perhaps we found these guppies in Asan River early enough to minimize the negative impact they might have on the native species and the river itself. Only time and continued stream monitoring will tell.

–Anne Farahi, NPS
Biological Technician

Orangeblack Hawaiian Damselfly

Damsels in Distress

Damsels vs. Dragons:

Damselflies and dragonflies are a type of insect called an odonate. Damselflies resemble dragonflies though they are smaller, more slender, and have rectangular rather than round heads. You can easily tell the difference between a damselfly and a dragonfly by the way they perch. Damselflies hold their wings closed above their body when at rest while dragonflies rest with their wings open.

Beautiful Hawaiian damselflies (*Megalagrion calliphya*) perching with closed wings

Featuring the Orangeblack Hawaiian Damselfly (*Megalagrion xanthomelas*):

Adults of this smaller species have a wingspan of 1.4-1.6 inches.
The male's head is black with large red eyes. The body (called the thorax) is striped red and black with red legs. The abdomen (the long tail-like appendage) is mostly black with a few red markings. Females have a similar coloration pattern though they are tan and black instead of red and black.

Habitat & Diet: This is a lowland species that tends to fly amid the vegetation bordering anchialine pools, coastal wetlands, and slow moving sections of streams. They catch and eat small insects out of the air by forming a basket with their spiny legs. They can also act as an ambush predator, watching patiently from a perch then pouncing on their prey.

A male orangeblack Hawaiian damselfly waiting in ambush?

They have been known to prey on insects larger then themselves and even other damselflies if the opportunity presents itself.

Reproduction: Small, cigar-shaped eggs are deposited into the tissues of lily pads and other aquatic plants. Ten to twenty days later, the eggs hatch. The immature damselfly larvae live in the water under submerged vegetation, and use gills to breath underwater. They periodically molt (shed their outer skin or exoskeleton) over several months until they become fully mature adults. When they mature, they crawl out of the water onto vegetation or rocks and molt one last time into a winged adults.

Tidbit: Adult damselflies will "play dead" as a defensive behavior if caught in a net. They will draw their legs up under their bodies and lie completely still for several seconds, until they spring to life and fly away.

Threats: Orangeblack Hawaiian damselflies are endemic to Hawaii. This means they occur nowhere else in the world. Historically, this species was one of the most abundant Hawaiian damselflies in the islands with the ability to breed in a wide variety of aquatic habitats. Since the 1970s, there has been a marked decrease in the population. Specifically, the human use and alteration of streams and groundwater has played a significant role in the loss of suitable habitat. Habitat loss and degradation of coastal water sources has led to the listing of the orangeblack Hawaiian damselfly as a candidate endangered species.

This species is also threatened by introduced species, particularly invasive plants (such as *Brachiaria mutica*) that form dense thickets which effectively eliminate access to open water. Invasive fish and shrimp also prey on damselfly larvae.

In National Parks: Once present on all the main Hawaiian Islands, these insects are no longer found on Kauaʻi. Localized populations have been recorded on Oʻahu, Maui, Molokaʻi, Lanaʻi, and Hawaiʻi Island. You may spot them around anchialine pools in Puʻuhonua o Hōnaunau National Historical Park (PUHO) and Kaloko-Honokōhau National Historical Park (KAHO). These sometimes cryptic damselflies have also been recorded near the mouth of Waikolu Stream in Kalaupapa National Historical Park.

Most active during periods of full sunlight, orangeblack Hawaiian damselflies usually hide in vegetation on cloudy days. The Pacific Island Network Inventory & Monitoring Program monitors populations of these and other odonates that reside around anchialine pools in west Hawaiʻi national parks.

–Anne Farahi, NPS
Biological Technician

For more info:http://www.xerces.org/orangeblack-hawaiian-damselfly/